

## Title (en)

PLANTS HAVING ENHANCED YIELD-RELATED TRAITS AND A METHOD FOR MAKING THE SAME

## Title (de)

PFLANZEN MIT VERBESSERTEN ERTRAGSEIGENSCHAFTEN UND VERFAHREN ZUR HERSTELLUNG DAVON

## Title (fr)

INSTALLATIONS DOTÉES DE CARACTÉRISTIQUES DE RENDEMENT AMÉLIORÉES ET PROCÉDÉ DE FABRICATION DE CELLES-CI

## Publication

**EP 2949661 A1 20151202 (EN)**

## Application

**EP 15162086 A 20100811**

## Priority

- EP 09168166 A 20090819
- EP 09168159 A 20090819
- EP 09168213 A 20090819
- EP 09168392 A 20090821
- EP 09168433 A 20090821
- EP 09168402 A 20090821
- US 25130909 P 20091014
- US 25130709 P 20091014
- US 25130809 P 20091014
- US 25131209 P 20091014
- US 25130609 P 20091014
- US 25131109 P 20091014
- EP 10740676 A 20100811
- EP 15162086 A 20100811

## Abstract (en)

The present invention relates generally to the field of molecular biology and concerns a method for enhancing yield-related traits in plants by modulating expression in a plant of a nucleic acid encoding a FSM1-like (Fruit Sant/Myb) polypeptide, or a PIF3-like (PHYTOCHROME INTERACTING FACTOR) polypeptide, or an Uroporphyrinogen III decarboxylase (UROD) polypeptide, or an AS-MTT (Abiotic Stress Membrane Tethered Transcription factor) polypeptide, or an EXO-1 polypeptide, or a YiAP2 ( Yield i ncreasing Ap etala 2 ) polypeptide. The present invention also concerns plants having modulated expression of a nucleic acid encoding a FSM1-like polypeptide, which plants have enhanced yield-related traits relative to corresponding wild type plants or other control plants. The invention also provides constructs useful in the methods of the invention.

## IPC 8 full level

**C07K 14/415** (2006.01); **C12N 15/82** (2006.01)

## CPC (source: CN EP US)

**C07K 14/415** (2013.01 - CN EP US); **C12N 15/8261** (2013.01 - CN EP US); **Y02A 40/146** (2017.12 - EP US)

## Citation (applicant)

- WO 2007144190 A2 20071221 - CROPDESIGN NV [BE], et al
- US 5811238 A 19980922 - STEMMER WILLEM P C [US], et al
- US 6395547 B1 20020528 - STEMMER WILLEM P C [US]
- US 5565350 A 19961015 - KMEIC ERIC B [US]
- WO 0015815 A1 20000323 - PIONEER HI BRED INT [US]
- WO 9322443 A1 19931111 - STANFORD RES INST INT [US]
- WO 9853083 A1 19981126 - ZENECA LTD [GB], et al
- WO 9953050 A1 19991021 - COMMW SCIENT IND RES ORG [AU], et al
- US 4987071 A 19910122 - CECH THOMAS R [US], et al
- US 5116742 A 19920526 - CECH THOMAS R [US], et al
- WO 9400012 A1 19940106 - GENE SHEARS PTY LTD [AU], et al
- WO 9503404 A1 19950202 - BIOCEM [FR], et al
- WO 0000619 A2 20000106 - UNIV IOWA STATE RES FOUND INC [US]
- WO 9713865 A1 19970417 - PLANT GENETIC SYSTEMS NV [BE], et al
- WO 9738116 A1 19971016 - GENE SHEARS PTY LTD [AU], et al
- WO 9836083 A1 19980820 - PLANT BIOSCIENCE LTD [GB], et al
- WO 9915682 A2 19990401 - PLANT BIOSCIENCE LTD [GB], et al
- EP 1198985 A1 20020424 - JAPAN AS REPRESENTED BY DIR GE [JP]
- WO 2007093444 A1 20070823 - CROPDESIGN NV [BE], et al
- WO 2004070039 A2 20040819 - CROPDESIGN NV [BE], et al
- US 5164310 A 19921117 - SMITH ROBERTA H [US], et al
- US 5159135 A 19921027 - UMBECK PAUL F [US]
- WANG ET AL., PLANTA, vol. 218, 2003, pages 1 - 14
- BARG ET AL., PLANTA, vol. 221, 2005, pages 197 - 211
- CORLEY ET AL., PROC. NATL. ACAD. SCI., vol. 102, 2005, pages 5068 - 5073
- BAXTER ET AL., PLANT J., vol. 52, 2007, pages 105 - 113
- CLACK ET AL., PLANT CELL, vol. 21, no. 3, March 2009 (2009-03-01), pages 786 - 99
- CASTILLON ET AL., TRENDS IN PLANT SCIENCE, vol. 12, no. 11, November 2007 (2007-11-01), pages 514 - 521
- MARTINS ET AL., THE JOURNAL OF BIOLOGICAL CHEMISTRY, vol. 276, no. 47, 23 November 2001 (2001-11-23), pages 44108 - 44116
- MOHANTY ET AL., PLANTA, vol. 224, 2006, pages 692 - 699
- MOCK; GRIMM, PLANT PHYSIOL., vol. 113, 1997, pages 1101 - 1112
- SEO ET AL., TRENDS PLANT SCI., vol. 13, no. 10, 2008, pages 550 - 556
- CHEN ET AL., CURR OPIN PLANT BIOL., vol. 11, no. 6, 2008, pages 695 - 701
- GIL-HUMANES ET AL., BMC PLANT BIOL., vol. 9, no. 1, 29 December 2008 (2008-12-29), pages 66
- KIM ET AL., MOL BIOL EVOL., vol. 23, no. 1, January 2006 (2006-01-01), pages 107 - 20
- CREIGHTON: "Proteins", 1984, W.H. FREEMAN AND COMPANY
- TERPE, APPL. MICROBIOL. BIOTECHNOL., vol. 60, 2003, pages 523 - 533

- SCHULTZ ET AL., PROC. NATL. ACAD. SCI. USA, vol. 95, 1998, pages 5857 - 5864
- LETUNIC ET AL., NUCLEIC ACIDS RES., vol. 30, 2002, pages 242 - 244
- MULDER ET AL., NUCL. ACIDS. RES., vol. 31, 2003, pages 315 - 318
- ALTMAN R., BRUTLAG D., KARP P., LATHROP R., SEARLS D.: "ISMB-94; Proceedings 2nd International Conference on Intelligent Systems for Molecular Biology", 1994, AAAI PRESS, article BUCHER; BAIROCH: "A generalized profile syntax for biomolecular sequences motifs and its function in automatic sequence interpretation", pages: 53 - 61
- HULO ET AL., NUCL. ACIDS. RES., vol. 32, 2004, pages D134 - D137
- BATEMAN ET AL., NUCLEIC ACIDS RESEARCH, vol. 30, no. 1, 2002, pages 276 - 280
- GASTEIGER ET AL.: "ExPASy: the proteomics server for in-depth protein knowledge and analysis", NUCLEIC ACIDS RES., vol. 31, 2003, pages 3784 - 3788
- NEEDLEMAN; WUNSCH, J MOL BIOL, vol. 48, 1970, pages 443 - 453
- ALTSCHUL ET AL., J MOL BIOL, vol. 215, 1990, pages 403 - 10
- CAMPANELLA ET AL., BMC BIOINFORMATICS, vol. 4, 10 July 2003 (2003-07-10), pages 29
- SMITH TF; WATERMAN MS, J. MOL. BIOL, vol. 147, no. 1, 1981, pages 195 - 7
- MEINKOTH; WAHL, ANAL. BIOCHEM., vol. 138, 1984, pages 267 - 284
- SAMBROOK ET AL.: "Molecular Cloning: a laboratory manual, 3rd ed.", 2001, COLD SPRING HARBOR LABORATORY PRESS
- "Current Protocols in Molecular Biology", 1989, JOHN WILEY & SONS
- FOISSAC; SCHIEX, BMC BIOINFORMATICS, vol. 6, 2005, pages 25
- CASTLE ET AL., SCIENCE, vol. 304, no. 5674, 2004, pages 1151 - 4
- HEID ET AL., GENOME METHODS, vol. 6, 1996, pages 986 - 994
- GATZ, ANNU. REV. PLANT PHYSIOL. PLANT MOL. BIOL., vol. 48, 1997, pages 89 - 108
- QING QU; TAKAIWA, PLANT BIOTECHNOL. J., vol. 2, 2004, pages 113 - 125
- TRIBBLE ET AL., J. BIOL. CHEM., vol. 275, 2000, pages 22255 - 22267
- VELMURUGAN ET AL., J. CELL BIOL., vol. 149, 2000, pages 553 - 566
- BUCHMAN; BERG, MOL. CELL BIOL., vol. 8, 1988, pages 4395 - 4405
- CALLIS ET AL., GENES DEV, vol. 1, 1987, pages 1183 - 1200
- FREELING AND WALBOT: "The Maize Handbook", 1994, SPRINGER, article "chapter 116"
- GAULTIER ET AL., NUCL AC RES, vol. 15, 1987, pages 6625 - 6641
- INOUE ET AL., NUCL AC RES, vol. 15, 1987, pages 6131 - 6148
- INOUE ET AL., FEBS LETT., vol. 215, 1987, pages 327 - 330
- HASELHOFF; GERLACH, NATURE, vol. 334, 1988, pages 585 - 591
- BARTEL; SZOSTAK, SCIENCE, vol. 261, 1993, pages 1411 - 1418
- ANGELL; BAULCOMBE, PLANT J, vol. 20, no. 3, 1999, pages 357 - 62
- HELENE, C., ANTICANCER DRUG RES., vol. 6, 1991, pages 569 - 84
- HELENE ET AL., ANN. N.Y. ACAD. SCI., vol. 660, 1992, pages 27 - 36
- MAHER, L.J., BIOASSAYS, vol. 14, 1992, pages 807 - 15
- SCHWAB ET AL., DEV. CELL, vol. 8, 2005, pages 517 - 527
- SCHWAB ET AL., PLANT CELL, vol. 18, 2006, pages 1121 - 1133
- KRENS, F.A. ET AL., NATURE, vol. 296, 1982, pages 72 - 74
- NEGRUTIU L ET AL., PLANT MOL BIOL, vol. 8, 1987, pages 363 - 373
- SHILLITO R.D. ET AL., BIO/TECHNOL, vol. 3, 1985, pages 1099 - 1102
- CROSSWAY A ET AL., MOL. GEN GENET, vol. 202, 1986, pages 179 - 185
- KLEIN TM ET AL., NATURE, vol. 327, 1987, pages 70
- CLOUGH; BENT, PLANT J., vol. 16, 1998, pages 735 - 743
- ALDEMITA; HODGES, PLANTA, vol. 199, 1996, pages 612 - 617
- CHAN ET AL., PLANT MOL BIOL, vol. 22, no. 3, 1993, pages 491 - 506
- HIEI ET AL., PLANT J, vol. 6, no. 2, 1994, pages 271 - 282
- ISHIDA ET AL., NAT. BIOTECHNOL, vol. 14, no. 6, 1996, pages 745 - 50
- FRAME ET AL., PLANT PHYSIOL, vol. 129, no. 1, 2002, pages 13 - 22
- S.D. KUNG AND R. WU: "Transgenic Plants, Vol. 1, Engineering and Utilization", vol. 1, 1993, ACADEMIC PRESS, article B. JENES ET AL.: "Techniques for Gene Transfer", pages: 128 - 143
- POTRYKUS, ANNU. REV. PLANT PHYSIOL. PLANT MOLEC. BIOL., vol. 42, 1991, pages 205 - 225
- BEVAN ET AL., NUCL. ACIDS RES., vol. 12, 1984, pages 8711
- HOFGEN; WILLMITZER, NUCL. ACID RES., vol. 16, 1988, pages 9877
- S.D. KUNG AND R. WU: "Transgenic Plants, Vol. 1, Engineering and Utilization", vol. 1, 1993, ACADEMIC PRESS, article F.F. WHITE: "Vectors for Gene Transfer in Higher Plants", pages: 15 - 38
- FELDMAN, KA; MARKS MD, MOL GEN GENET, vol. 208, 1987, pages 1 - 9
- C KONCZ, N-H CHUA AND J SHELL: "Methods in Arabidopsis Research", 1992, WORLD SCIENTIFIC, article FELDMANN K, pages: 274 - 289
- CHANG, PLANT J., vol. 5, 1994, pages 551 - 558
- KATAVIC, MOL GEN GENET, vol. 245, 1994, pages 363 - 370
- BECHTHOLD, N, C R ACAD SCI PARIS LIFE SCI, vol. 316, 1993, pages 1194 - 1199
- CLOUGH, SJ; BENT AF, THE PLANT J, vol. 16, 1998, pages 735 - 743
- KLAUS ET AL., NATURE BIOTECHNOLOGY, vol. 22, no. 2, 2004, pages 225 - 229
- BOCK: "Transgenic plastids in basic research and plant biotechnology", J MOL BIOL., vol. 312, no. 3, 21 September 2001 (2001-09-21), pages 425 - 38
- MALIGA, P: "Progress towards commercialization of plastid transformation technology", TRENDS BIOTECHNOL., vol. 21, 2003, pages 20 - 28
- HAYASHI ET AL., SCIENCE, 1992, pages 1350 - 1353
- KONCZ C, CHUA NH, SCHELL J: "Methods in Arabidopsis Research", 1992, WORLD SCIENTIFIC PUBLISHING CO, article REDEI GP; KONCZ C, pages: 16 - 82
- MEYEROWITZ EM, SOMERVILLE CR: "Arabidopsis", 1994, COLD SPRING HARBOR LABORATORY PRESS, article FELDMANN ET AL., pages: 137 - 172
- J MARTINEZ-ZAPATER, J SALINAS: "Methods on Molecular Biology", vol. 82, 1998, HUMANA PRESS, article LIGHTNER J; CASPAR T, pages: 91 - 104
- MCCALLUM ET AL., NAT BIOTECHNOL, vol. 18, 2000, pages 455 - 457
- STEMPEL, NAT REV GENET, vol. 5, no. 2, 2004, pages 145 - 50
- OFFRINGA ET AL., EMBO J, vol. 9, no. 10, 1990, pages 3077 - 84
- TERADA ET AL., NAT BIOTECH, vol. 20, no. 10, 2002, pages 1030 - 4
- LIDA; TERADA, CURR OPIN BIOTECH, vol. 15, no. 2, 2004, pages 132 - 8
- MILLER ET AL., NATURE BIOTECHNOL., vol. 25, 2007, pages 778 - 785
- RABBANI ET AL., PLANT PHYSIOL, vol. 133, 2003, pages 1755 - 1767
- SAMBROOK J; FRITSCH EF; MANIATIS T: "Molecular Cloning, A Laboratory Manual", 1989
- LANDER ET AL., GENOMICS, vol. 1, 1987, pages 174 - 181
- BOTSTEIN ET AL., AM. J. HUM. GENET., vol. 32, 1980, pages 314 - 331

- BERNATZKY; TANKSLEY, PLANT MOL. BIOL. REPORTER, vol. 4, 1986, pages 37 - 41
- HOHEISEL ET AL.: "Non-mammalian Genomic Analysis: A Practical Guide", ACADEMIC PRESS, pages: 319 - 346
- TRASK, TRENDS GENET., vol. 7, 1991, pages 149 - 154
- LAAN ET AL., GENOME RES., vol. 5, 1995, pages 13 - 20
- KAZAZIAN, J. LAB. CLIN. MED, vol. 11, 1989, pages 95 - 96
- SHEFFIELD ET AL., GENOMICS, vol. 16, 1993, pages 325 - 332
- LANDEGREN ET AL., SCIENCE, vol. 241, 1988, pages 1077 - 1080
- SOKOLOV, NUCLEIC ACID RES., vol. 18, 1990, pages 3671
- WALTER ET AL., NAT. GENET., vol. 7, 1997, pages 22 - 28
- DEAR; COOK, NUCLEIC ACID RES., vol. 17, 1989, pages 6795 - 6807
- BAILEY; ELKAN: "Proceedings of the Second International Conference on Intelligent Systems for Molecular Biology", 1994, AAAI PRESS, pages: 28 - 36
- R.D. FINN; J. TATE; J. MISTRY; P.C. COGGILL; J.S. SAMMUT; H.R. HOTZ; G. CERIC; K. FORSLUND; S.R. EDDY; E.L. SONNHAMMER, NUCLEIC ACIDS RESEARCH, 2008, pages D281 - D288
- BAILEY ET AL., NUCLEIC ACIDS RESEARCH, vol. 34, 2006, pages W369 - W373
- LETUNIC ET AL., NUCLEIC ACIDS RES, vol. 34, 2006, pages D257 - D260
- OHME-TAKAGI; SHINSHI, PLANT CELL, vol. 7, 1995, pages 173 - 182
- LIU ET AL., FEBS LETT., vol. 580, no. 5, 2006, pages 1303 - 8
- YOH-SAKUMAA, BIOCHEMICAL AND BIOPHYSICAL RESEARCH COMMUNICATIONS, vol. 290, 2002, pages 998 - 1009
- MIDDLETON ET AL., PLANT CELL, vol. 19, 2007, pages 1221 - 1234
- KIZIS; PAGES, PLANT J., vol. 30, no. 6, 2002, pages 679 - 89
- JACOBS; JACOBS, PLANT PHYSIOL., vol. 101, no. 4, 1993, pages 1181 - 1187
- IVANETICH ET AL., CLIN CHEM., vol. 30, no. 3, 1984, pages 391 - 4
- MARTINS ET AL., J BIOL CHEM., vol. 276, no. 47, 2001, pages 44108 - 44116
- KATOH; TOH, BRIEFINGS IN BIOINFORMATICS, vol. 9, 2008, pages 286 - 298
- HOUWE ET AL., BIOINFORMATICS, vol. 18, no. 11, 2002, pages 1546 - 7
- HUDSON ET AL., BIOINFORMATICS, vol. 8, no. 1, 2007, pages 460
- SAMBROOK: "Molecular Cloning: a laboratory manual, 3rd ed.", 2001, COLD SPRING HARBOR LABORATORY PRESS
- AUSUBEL ET AL.: "Current Protocols in Molecular Biology", vol. 1, 2, 1994, CURRENT PROTOCOLS
- R.D.D. CROY: "Plant Molecular Biology Labfax", 1993, BIOS SCIENTIFIC PUBLICATIONS LTD (UK)
- ALTSCHUL ET AL., J. MOL. BIOL., vol. 215, 1990, pages 403 - 410
- ALTSCHUL ET AL., NUCLEIC ACIDS RES., vol. 25, 1997, pages 3389 - 3402
- THOMPSON ET AL., NUCLEIC ACIDS RES, vol. 25, 1997, pages 4876 - 4882
- CHENNA ET AL., NUCLEIC ACIDS RES, vol. 31, 2003, pages 3497 - 3500
- HOWE ET AL., BIOINFORMATICS, vol. 18, no. 11, 2002, pages 1546 - 7
- HUSON ET AL., BMC BIOINFORMATICS, vol. 8, no. 1, 2007, pages 460
- BMC BIOINFORMATICS, vol. 4, 2003, pages 29
- PARK; KANEHISA, BIOINFORMATICS, vol. 19, 2003, pages 1656 - 1663
- LI; PARISH, PLANT J., vol. 8, 1995, pages 963 - 972
- AI-SADY ET AL., MOLECULAR CELL, vol. 23, no. 3, 4 August 2006 (2006-08-04), pages 439 - 46
- JACOBS, PLANT PHYSIOL., vol. 101, no. 4, 1993, pages 1181 - 1187
- FURUKAWA ET AL., PLANT MOL BIOL, vol. 66, 2008, pages 519 - 531
- FURUKAWA ET AL., PLANT MOLECULAR BIOLOGY, vol. 51, 2003, pages 59 - 70
- ISHIDA ET AL., NATURE BIOTECH, vol. 14, no. 6, 1996, pages 745 - 50
- BABIC ET AL., PLANT CELL REP, vol. 17, 1998, pages 183 - 188
- MCKERSIE ET AL., PLANT PHYSIOL, vol. 119, 1999, pages 839 - 847
- BROWN DCW; A ATANASSOV, PLANT CELL TISSUE ORGAN CULTURE, vol. 4, 1985, pages 111 - 112
- WALKER ET AL., AM J BOT, vol. 65, 1978, pages 654 - 659
- GAMBORG ET AL., EXP. CELL RES., vol. 50, 1968, pages 151 - 158

#### Citation (search report)

- [A] WO 2007099096 A1 20070907 - CROPDESIGN NV [BE], et al
- [A] WO 2009000789 A1 20081231 - CROPDESIGN NV [BE], et al
- [X] H. GAO ET AL: "A membrane-tethered transcription factor defines a branch of the heat stress response in Arabidopsis thaliana", PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES, vol. 105, no. 42, 21 October 2008 (2008-10-21), pages 16398 - 16403, XP055206957, ISSN: 0027-8424, DOI: 10.1073/pnas.0808463105
- [A] CHEN Y N ET AL: "Membrane-tethered transcription factors in Arabidopsis thaliana: novel regulators in stress response and development", CURRENT OPINION IN PLANT BIOLOGY, QUADRANT SUBSCRIPTION SERVICES, GB, vol. 11, no. 6, 1 December 2008 (2008-12-01), pages 695 - 701, XP025685974, ISSN: 1369-5266, [retrieved on 20081118], DOI: 10.1016/J.PBI.2008.10.005

#### Designated contracting state (EPC)

AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR

#### DOCDB simple family (publication)

**WO 2011020746 A1 20110224**; AR 079406 A1 20120125; AU 2010285126 A1 20120301; AU 2010285126 A2 20120607; BR 112012003796 A2 20161122; CA 2770438 A1 20110224; CN 102686604 A 20120919; CN 104530202 A 20150422; EA 201200284 A1 20130329; EP 2467394 A1 20120627; EP 2467394 B1 20150429; EP 2949661 A1 20151202; ES 2542536 T3 20150806; MX 2012002045 A 20120411; US 2012144529 A1 20120607; US 2016083743 A1 20160324; ZA 201201875 B 20130529

#### DOCDB simple family (application)

**EP 2010061657 W 20100811**; AR P100103046 A 20100819; AU 2010285126 A 20100811; BR 112012003796 A 20100811; CA 2770438 A 20100811; CN 201080046942 A 20100811; CN 201410759248 A 20100811; EA 201200284 A 20100811; EP 10740676 A 20100811; EP 15162086 A 20100811; ES 10740676 T 20100811; MX 2012002045 A 20100811; US 201013390563 A 20100811; US 201514840153 A 20150831; ZA 201201875 A 20120314